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Digital Aesthetics: The Discrete and the Continuous

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Abstract
Aesthetic investigations of computation are stuck in an impasse, caused by the difficulty of accounting for the ontological discrepancy between the continuity of sensation and the discreteness of digital technology. This article proposes a theoretical position intended to overcome that deadlock. It highlights how an ontological focus on continuity has entered media studies via readings of Deleuze, which attempt to build a 'digital aisthesis' (that is, a theory of digital sensation) by ascribing a 'virtuality' to computation. This underpins, in part, the affective turn in digital theory. In contrast to such positions, this article argues for a reconceptualization of formal abstraction in computation, in order to find, within the discreteness of computational formalisms (and not via the coupling of the latter with virtual sensation), an indeterminacy that would make computing aesthetic qua inherently generative. This indeterminacy, it is argued here, can be found by reconsidering, philosophically, Turing's notion of 'incomputability'.

Keywords
aesthetics, affect, computation, Deleuze, digitality, ontology, virtuality

An Impasse in Digital Aesthetics

Is aesthetics a viable mode of investigating digital computation? This question is as important as it is pressing, for it brings to the fore an impasse that, in my view, currently afflicts contemporary aesthetic enquiries into digital media. On the one hand, this impasse attests to the relentless expansion of modes of thinking, acting and perceiving that have been enabled by, and which are specific to, digital technologies. On the other hand, however, it also reflects the widespread belief that these digitally 'native' modes of thinking, acting and perceiving are imperfect or inferior if they are not validated by a biological substrate, a human referent, a body, or simply 'life', which expresses and catalyses

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the affects and sensations that are held to be central to aesthetic experience. The deadlock in digital aesthetics that I wish to foreground here thus concerns the difficulty of attributing those perceptual and relational features that are the object of the aesthetic enquiry, and which characterize lived experience, to the informational and operational mechanisms of the computer or the digital device.

In this article, I will propose a theoretical position that attempts to move beyond this deadlock. I will argue that an aesthetics of the digital is possible, and that computation itself, as a method of systematizing reality through quantitative means and as the logical motor of digital technologies, can be addressed in aesthetic terms. My affirmative response to the question of whether aesthetics is a viable mode of investigating digital computation, however, involves taking aesthetics beyond the traditional tenets of the discipline, such as beauty, taste and judgement, and also beyond traditional concerns with art (in general) or with art made with computers (in the specific). The aesthetic investigation of digital media that I propose is in fact grounded upon an *ontological study of digital computation*. It is my contention that this study is necessary, because the impasse in digital aesthetics that I referred to above also amounts to a deadlock between two opposed ontological registers, or two antithetical modes of being: *continuity* and *discreteness*.

Continuity and discreteness might be said to qualify, respectively, the aesthetic and the digital. Broadly speaking, aesthetics pertains to sensuous experiencing: to properties, features and qualities that rely on the continuity of perceptual and sensuous relations. Conversely, the digital is a data technology that uses discrete (that is, discontinuous) values to represent, store and manage information. Taking this into consideration, the impasse in digital aesthetics can then be interpreted as a standoff between two conflicting ways of grasping and structuring the real. Aesthetics, being predicated upon perceptual relations and sensations, would seem to require a continuous, and thus analogue, association with the world. Digital technology, with its binary elaboration of reality through quantifiable mechanical operations and quantitative inputs and outputs, attends to the real by discretizing it. A mode of organization that is said to be aesthetically primary, because it pertains to the qualitative features that belong to the perception and receptivity of lived experience, is thus opposed to an alternative structuring, which is dictated by digital technologies' quantitative modes of formal organization. We are therefore witness to a contradiction. Whilst there are a few sociocultural operations and activities today that are not entangled with informational mechanisms of discretization, aesthetic investigations of the digital still arguably break down, at a conceptual level, when trying to cope with the discreteness of the digital machine. To ask, as I do here, whether a digital aesthetics is indeed possible involves, therefore, addressing the challenge of accounting, on a theoretical ground,

for the inherent ontological discrepancy between that which is continuous (perception and sensation) and that which is not (digital technology). The aim of this article is to address some of the issues and difficulties involved in such a project, and to set out some initial suggestions as to how it might be pursued.

The Continuity of Thought and Sensation: Gilles Deleuze's Aesthetic Philosophy

With these goals in mind, we should begin by first considering how the link between aesthetics (as a mode of philosophical enquiry) and continuity (as a mode of being) has been forged, and how it entered the cultural theory of digital technology. An initial step in this direction can be taken by highlighting the etymological root of the term 'aesthetics'. The word stems from the Greek *aísthēsis,* which means 'perception from the senses', 'feeling' and 'sensation', and which, via the influence exerted by Baumgarten's *Aesthetica* of 1750, came to denote 'sensory knowledge'. Although, after Hegel, the modern discipline of aesthetics stands as a synonym for a 'theory of art' (see Hegel, 1975), if we return to this original etymological sense of aesthetics, the term could be said to refer to theories of sensory relations concerned with the examination of how we relate to things, and how these things in turn relate to other things. From this standpoint, aesthetics is 'relational' not just by virtue of artistic activity connecting levels of reality according to periods or social contexts, and thus mediating relationships whose forms and functions evolve over time – as theorized, for example, by Bourriaud (2002). In contrast, aesthetics is relational because it is a mode of philosophical enquiry that opposes any existential modality that separates life, thought and sensation. According to this 'aisthetic' view, the continuous is not only the perceptual recording of reality that aesthetics attests to, but also reality itself, in its relational infinity of variations, modulations and transformation: relations that aesthetics aims to record and take account of through the sensible.

Arguably, when Gilles Deleuze proposed his own aesthetic philosophy, it was *aisthesis*, understood as a theory of sensory relations, to which he turned. It is precisely Deleuze's aesthetic philosophy that I wish to address here, because current associations of aesthetics with an ontological field of continuity – within and beyond digital culture – could be said to develop, in part, from his philosophy. Ontological continuity is a key feature of Deleuze's elaboration of aesthetics-as-aisthesis. For Deleuze, the continuum is the metaphysical plane of transformation of what is prior to individuation, of what is not logically predetermined, and of what instead creates through difference. Such a metaphysical plane of continuous variation is, according to Deleuze, life itself. This is neither 'my life' nor 'your life'. Deleuze was not interested in the life of

the self, or any other particular life in the world. Rather, he talked of 'a life' (Deleuze, 2001) in the sense of a field of potential realization that is impersonal, indefinite and subjectless. 'A life' is never completely specified and never separated from its unactualized conditions. For Deleuze, aesthetics is exactly what gives us the opportunity to address these unactualized conditions, insofar as it concerns one's unmediated relation with the sensible dimension upon which these unactualized conditions find expression.

These comments show that the link between aesthetics and continuity carries a profound Deleuzian connotation. My point, however, is that so too does the ontological standoff that I am staging here between continuity and discreteness in digital aesthetics. This claim needs to be unpacked slowly, by clarifying, first of all, that whilst Deleuze engaged with media such as television, radio and – above all – cinema, he wrote very little (and not fondly) about computers. This little that Deleuze wrote on computing has emphasized the limitations and complacencies of the digital medium in relation to contemporary society's capitalist systems of control (Deleuze, 1992; see also Galloway, 2012). In a sense, it is thus somewhat paradoxical that, despite Deleuze's overt suspicion towards computational regimes of power and communication, his metaphysical vocabulary of 'rhizomes', 'assemblages', 'bodies without organs' and 'abstract machines' has nonetheless found much currency within digital media studies. The influence that Deleuze's metaphysics of becoming has exerted over the cultural study of digital technologies can, however, also be explained by considering how a conceptual apparatus of intensities, multiplicities and affirmations would seem to be particularly apt to describe a technomediated society which is – and whose media and modes of production are – without a centre and in continuous flow. This metaphysical vocabulary of becomings has thus been deployed as 'a toolkit of concepts that can be used to understand media at an immanent level' (Harper and Savat, 2016: 2), and applied to describe what Negroponte (1996) once called 'being digital'. From internet networks (Buchanan, 2007) to computer games (Cremin, 2016), this application of Deleuze's conceptual toolkit has today come to include large parts of new technology (see Poster and Savat, 2009).

In the light of these considerations, it is crucial to stress how Deleuze never explicitly addressed the aesthetics of the digital. Similarly, in the light of the current uses (and, sometimes, abuses) of Deleuze's metaphysical concepts, it is also important to emphasize how Deleuze's ontology precludes such an aesthetics, because it does not support claims about 'digital sensation' or 'digital perception'. For Deleuze, the discreteness of techniques of formalization such as computing is problematic, inasmuch as it exemplifies yet another development of the representational. That is to say, a development of that which breaks the unmediated relation of

thought with the sensible and thus separates thinking from affect and intuition – the former being understood in the Spinozist sense of a variation in the *potentia agendi* of a body (Spinoza, 1949: 128), and the latter in the Bergsonian sense of a method of unmediated and immediate 'sympathy' (Bergson, 1997: 135) with things. In this respect, Deleuze's argument is implicit yet straightforward: computing is a discipline that corrupts what it means to think, insofar as it participates in 'a race for the universals of communication' (Deleuze and Guattari, 1994: 11). For Deleuze, such a 'quest for ''universals of communication'' ought to make us shudder' (Deleuze, 1995: 175), because it results in an increasingly abstractive infrastructure, a cognitive representation, or indeed what Deleuze would have called a traditional and dogmatic 'image of thought' (Deleuze, 2004), which stops the lived potential of thinking. Deleuze's reworking of aesthetics stresses this lived potential, and presupposes the immanence of thinking and feeling upon which this lived potentiality is expressed. The sensory knowledge that aesthetics is about is also predicated upon this immanence: there is thought in aesthetics, but this thinking is enmeshed, inextricably, with the sensibility of the real.

Of course, Deleuze is not the only one to have cast the continuity of thought and sensation against the discreteness of those techno-formal strategies that want to bind both thinking and feeling into an automated mechanism. The phenomenological tradition in philosophy offers another good example here, with its focus on the meaningful and rich continuity of an intentional and reflexive relation between a perceiver and a perceived. Moreover, this disparity between the limitations of the technological (with its representational and cognitive character) and the irreducibility of the thinking that comes from lived experience and sensation (which both surpass cognitive representation) has often been addressed in Frankfurtian critiques of instrumental reason, as well as in post-structuralist, postmodernist and post-Marxist oppositions to the mechanization of life. I acknowledge these other entry points to the impasse between continuity and discreteness that I find in digital aesthetics. However, I would also maintain that the setting of this deadlock between continuity and discreteness remains characteristically Deleuzian, and that this is the form in which it has entered the cultural theory of computational media. As the reader will see, my own aesthetic proposition for digital computation differs from that of Deleuze-inspired perspectives. Nonetheless, since one of my central claims is that the deadlock in contemporary aesthetic investigations of the digital concerns aesthetics in the sense of an ontological investigation, I would argue that we need to start from the ontological terms that Deleuze so poignantly and originally set out in relation to the scope and reach of aesthetic enquiries.

Digital Aisthesis?

To claim that, for Deleuze, an aesthetics of the digital would be a contradiction in terms does not equate to saying that a Deleuzian aesthetics of the digital has not been attempted. Whilst it should be stressed that the status quo of digital media studies is *not* unanimously and universally informed by the philosophy of Gilles Deleuze, issues pertaining to aesthetics-as-aisthesis have entered digital media theory and the cultural theory of technology partially, but influentially, through appropriations and elaborations of Deleuze's aesthetic proposition. In order to continue to consider whether an aesthetics of digital computation is possible, we should address these appropriations and elaborations, so that I can also distinguish them, and the 'digital aisthesis' that they aim to establish, from my own attempt at pursuing a computational aesthetics of discreteness.

According to Deleuze, it is not uniquely the body or the subject, but the *sensible* in general that rises to the role of the recorder of experience. Experience, in this view, is not the Humean accumulation of clear and cut facts but, rather, counts as the dimension of what is lived; equally, sensation is not just what belongs to the senses, but what strikes us before meaning is trapped into figuration and signification. In what I am characterizing here as an 'aisthetic approach' to the digital, this central role of sensibility is also maintained, and in fact applied, to the digital realm. In an aisthesis of the digital, the sensible becomes key to shaping the arrangement of human-machine relations, for it brings the continuous, infinite movement of experiential, lived dynamics into what is static and finite, such as the digital machine. The sensible might then be the human user in her interaction with the machine. However, in a non-anthropocentric fashion, the sensible also includes the material residues of the social, the cultural and the economical milieu, as these entwine with the technological and the informational planes. The 'new philosophy for new media' that Mark B. N. Hansen proposes constitutes a good example to contextualize these claims. In his scholarly work, from *Embodying Technesis* (2000) to the most recent *Feed-Forward* (2015), via *Bodies in Code* (2006) and the aforementioned *New Philosophy for New Media* (2004), Hansen enters in conversation with Deleuze, Bergson and the post-Husserlian phenomenological tradition in order to affirm how the material forces of technology (and digital technology, in particular) expand and amplify the role of embodiment and sensation (or, as he has been proposing more recently, 'worldly sensibility'; see Hansen, 2015) in 21st-century society and culture. This role is, for Hansen, infrastructural and operative 'below the ''threshold'' of representation itself' (Hansen, 2000: 4). From this perspective, what I referred to earlier as 'digital aisthesis' can be understood in terms of a 'haptic aesthetics rooted in embodied affectivity' (Hansen, 2004: 12), corresponding to the non-cognitive and nondiscoursive experience of information itself.

Treating this attention to sensation as a central feature of the aisthetic approach to the digital allows me to advance the following point. On the aisthetic view, the qualitative remains intrinsically superior to the quantitative. For there to be an aisthesis of the digital, the quantitative representations, operations and abstractions of digital technology must be brought back to the qualitative plane of sensuous differentiation where, from an aisthetic perspective, the continuous variation of the real takes place. Attempts to establish a digital aisthesis then encounter what I would characterize as a conceptual problem, which is as follows. Their implied conclusion is that the quantitative character of digital technology has to be 'corrected' in order to be more aesthetic, and the implicit theoretical operation that allows this correction involves amending what is more specific to digital computing: discreteness. For example, again in Hansen – and as I have argued elsewhere (see Fazi, 2016a) – the calculative specificity of digital media is sidestepped, or indeed black-boxed, in order to favour instead the techno-human experience of these media, in its qualitative rendition. The struggle of thinking discreteness and aesthetics together thus remains. Moreover, one can see here the fundamental difficulty faced by an aisthesis (i.e. a sensory knowledge) of the digital. This difficulty concerns the possibility (or impossibility) of assigning a productive capacity to the informational, calculatory, codified structures of digital computing. The dynamic and generative power of sensation contrasts with the static nature of the formal, finite and binary means through which the digital computing machine harnesses the lived. The richness and density of sensation, at the core of aesthetics-as-aisthesis, thus clashes with the computer, understood as both product and producer of cognitive abstractions and logocentric representations.

The conflict that an aisthetic approach to the digital has to deal with, then, is that between what supposedly can create the new and what supposedly cannot. Novelty, according to a Deleuzian framework, belongs to continuity, not to discreteness: novelty is produced in the continuous matter-flow of sensibility and in thoughts without an image (namely, in thinking which poses itself as a self-engendering act of creation). Working through possibilities and probabilities, however, digital computers can only represent through prediction and recollection. Supposedly, no new thought as well as no new sensibility can be produced because everything is already set up. From this perspective, then, the aesthetic limits of computing are to be found in the separateness of all those techno-formalizations that try to channel the viscosity of sensation (and of the immanence of thought to the latter) into a self-contained formal structure of calculation and evaluation, where thinking is separated from feeling and becomes inherently representational and deterministic. To phrase this once again in terms of an ontological impasse, one could depict this as a metaphysical disagreement between

the *indeterminacy* of the lived, on the one hand, and the *determinism* that the digital machine needs in order to operate and function, on the other.

The Limits of the Affective Turn

In a Deleuzian ontological setting, this indeterminacy, which cannot be cognized or represented, but rather only felt, is the indeterminacy of the virtual. Objecting to the confinement of the real within the realm of actual, representable and identifiable things, Deleuze made the virtual a productive field where the unexhausted conditions of the real are generated and expressed. The ontological continuity upon which Deleuze's philosophy and aesthetics are based is this productive virtual field. In this respect, the question that an aisthesis of the digital needs to confront concerns the fact that digital technologies would not seem to allow for the metaphysical dimension of potential relations and becomings proper to the virtual. What I described earlier as the inclination of digital aisthesis towards translating the quantitative into the qualitative can now be interpreted as an effort to overcome this issue: to endow digitality with a virtual aspect, and to thus respond to the famous thesis about the *superiority of the analogue* proposed by Brian Massumi (2002: 133–43). The superiority that Massumi refers to is ontological, and should be understood vis-à-vis Deleuze's belief in the metaphysical supremacy of the continuum over the discrete. Drawing directly from Deleuze's conception of virtuality (which, in turn, comes from Bergson), Massumi characterizes digital technology's processes of quantification and codification as operations that are unable to render the continuity of life's virtual transformations, and which can only approximate, but never fully grasp, life's ontogenetic conditions. Whilst, for Massumi, the digital is 'a numeric way of arraying alternative states' (2002: 137) that combines and systematizes the possible (for only possibility can be approached quantitatively), the analogue remains 'superior' because of its capacity to be, instead, a pure potentiality in becoming.

Interestingly, Steve Goodman (2010: 118) comments that Massumi's thesis asks cultural theory and philosophy to discover where the ontological potential for invention is, in both the analogue and the digital dimension. In response to this, one can note how the arduous task of endowing digitality with its own actual and virtual dimensions has been adopted by the *affective turn* in new media theory, a turn that can also be read as advancing multiple efforts to offer an aisthesis of the digital of the kind that I analyzed above. This attention towards the affects of digital technology merges with a broader affective current in the humanities and social sciences (see Clough, 2010; Clough and Halle, 2007), which Claire Colebrook has described in terms of an 'insistent narration of counter-Cartesianism, counter-linguisticism and antihumanism', grounded on an attention to life which has worked as 'a release from assumed norms and

models in favour of a genesis or emergence that has no principle outside that of plasticity or relationality in general' (2010: 30).

As regards digital studies and new media theory, this affective turn has often focused on the way in which the digital does not exhaust the virtuality of the real, and yet it is entangled with it through the sensibilities in which it partakes. Although it is definitely materialist, this affective perspective does not, however, reduce matter to a specific corporeal definition, and nor does it explain a body through its organs and functions. A body can indeed be anything – a sound, a speed, a virus, a vibration: 'every relationship of forces constitutes a body' (Deleuze, 2006: 37) – and its structure is expressed by the interplay of the affects that it is capable of producing. From this affective standpoint, the digital can be interwoven or associated with this material structure as long as it enters into the composition of its relations and distributions of virtual potentials. The affective turn in media theory thus focuses on the modes in which this composition is possible and becomes 'lived' in occasions such as those provided by design (Marenko, 2015), literature and poetry (Colebrook, 2012), architecture (DeLanda, 2002; Grosz, 2001; Massumi, 1998), biomedia and biotechnology (Clough, 2010; Parisi, 2004), computer simulations (DeLanda, 2011), new media and software art (Munster, 2006; Murray, 2008), human-computer interfaces (Hansen, 2003), film and screen cultures (Pisters, 2012), sound (Goodman, 2010), movement and dance (Manning, 2009; Portanova, 2013), and the technological mediation of time (Barker, 2012). These arenas of enquiry, amongst many others, have been rethought through the lenses of a 'Digital Deleuze' (Murray, 2009), thanks to interdisciplinary scholarly debates that have both advocated and advanced the possibility of such digital reading of Deleuze's philosophy.

Although it often directly referred to Deleuze's concept of the virtual, much of the rhetoric about virtuality that characterized 1990s cybertheory and cyberculture (see, for instance, the proposition of Lévy, 1998) lacked 'the material complexity of Deleuze and Guattari's plane of immanence' (Marks, 2006: 196). Alongside its other merits, then, I would argue that the affective turn can be seen to have productively remedied such reductions. The affective turn in new media theory has indeed produced sophisticated efforts to think the digital in its ambivalences and complexities, and also to highlight what Deleuzian philosophy can positively offer to contemporary critical engagements with computing and computational culture. As such, the many voices that compose this turn should be appreciated for the originality of their propositions. Stephen Zepke, describing the 'new aesthetic paradigm' that can be drawn from Deleuze (and Deleuze and Guattari), comments that 'the immanence of virtual and actual, of infinite and finite dimensions implies new questions: [. . .] not ''what thing or idea does it represent'' but ''what virtual universe does it embody or express?''' (2005: 155). Significantly,

the turn to affect in new media studies has helped to think what such a 'non-representational theory' (Thrift, 2008) of digital media might be, away from what media signify or communicate (see Murphie, 1996), and more in terms of what they do (that is, in terms of their affects/effects).

In this sense, the affective turn in media theory also feeds into contextual debates about modes of control, consumption and production in informational late-capitalist societies. As argued by Hardt and Negri (2005), these are modes that exploit the affective insofar as they invest the constitution of subjectivities and collectivities at a noncognitive level. Moreover, and from a different perspective, the aesthetic-affective attention to the non-representational side of digitality can also be seen to correspond, on a more technological level, to the cross-disciplinary call to engage with the 'material poiesis of informatics' (Mitchell and Thurtle, 2004: 2) that has enabled a vast variety of research landscapes and practical applications to establish and flourish. Computer-mediated environments are studied together with the use of hybrid computational-physical materials, so as to recreate states of intensity along the spectrum of the scales of sensible variations between the human body, the machine body, and all the infinitesimal steps in between.

Having introduced and explained these important points, my argument now develops as follows. What the affective turn in media studies is ultimately after is an entanglement of the digital with the virtual. What is sought for, in other words, is the virtuality that might be immanent to computing. From this perspective, any possibility for the digital to fully express its ontological potential must still be fundamentally predicated on the plane of the encounter (or straightforward clash) of digital technologies with what Deleuze called 'the being of the sensible' (2004: 176). According to this affective scenario, a full palette of virtual sensations must then be distributed amongst agents with different capacities and levels of receptivity. Within cultural theory, Anna Munster (2013) talks explicitly of 'aesthesia' to describe this intensive palette of virtual sensations. It is useful to focus on her proposition here, so as to give a concrete example of the way in which the affective turn in new media theory attempts to respond to Massumi's challenge to locate where the potential for creation lies in the digital.

Borrowing largely from a Deleuzian vocabulary, Munster focuses on the intersections between material and immaterial forces engendered by information technologies. She understands digital code as part of a mutual interplay of immediacies, losses and complexities that lies at the juncture of the human-computer interface. In this respect, Munster acknowledges a potentiality proper to digitality. The aesthetics that she is pursuing is not the result of direct sense-data perception, but travels instead at the level of body-code, and is thus irreducible to spatiotemporal coordinates of specific sociocultural constructions. For Munster,

there is always a something that exceeds experience: a surplus that cannot be placed at either the level of materiality or that of coding. Such a body-code perceptual unity forms a whole that is greater than any of its parts. The special configurations between information and materiality necessary for what she calls 'digital embodiment' (Munster, 2006) aim to disrupt any pregiven formation, as they arise immanently from the outcomes of lived interactions themselves.

Munster's proposition should be understood as a strong instance of what I have called earlier an 'aisthetic approach' to digital technology. In respect to Munster's proposition, however, I would highlight how, in describing digitality, her argument gives to the digital the 'analogue' proprieties that Deleuze assigned to the virtual. An objection could then be raised in connection to this operation. The enhanced view of materiality that Munster's argumentation puts forward proposes to understand 'the incorporeal vectors of digital information' (Munster, 2006: 19) as perpetual fluxes of related variables. These sets of variables are said to find the reason for their informational existence thanks to their virtual participation in a pre-representational status that always breaks away from rational synthesis and logocentric descriptions. In effect, Munster *virtualizes* the digital, thereby making it a negotiable continuum, the existence of which must be assumed if we are to participate in the experiential 'approximate aesthetics' (Munster, 2001) of proximities that she longs for.

It is also the case, then, that from this perspective, and despite a certain degree of engagement with the technicality of digital information, Munster's affective aesthetics of the digital bypasses what the digital is (that is, discrete), on a technical as much as ontological level, in order to focus on what the digital is not (i.e. continuity). Again, the implicit assumption of a digital aisthesis, such as Munster's, would then be this: if we want to address digital technologies in aesthetic terms, we need to revise its quantitative functions in terms of qualitative vectors of modulation and differentiation, or couple them with material and affective proprieties (such as for instance those of art, or of society and culture) that would negotiate the numerical operations of the digital machine. To sum up: aisthetic accounts of digital systems adopt Deleuze's aesthetics of ontological continuity and extend it to account for what is not continuous, and for what Deleuze himself would never have considered as aesthetic: digital computation.

Against the Virtualization of Digital Computation

Can the digital be virtual, then? Having raised this question I can now be a little more specific as regards the nature of my own proposition, and begin to argue that, for me, the digital is not virtual, and nor should it be. On this point, I am in agreement with Massumi. However, at the same

time, I also depart from his thesis concerning the superiority of the analogue. In my view, this disparity does not mean that the digital is in any way inferior to the analogue: it simply means that the digital is something other than virtuality, and that its potential should be found elsewhere. Drawing from Deleuze, I too understand aesthetics as an enquiry pertaining to the ontological possibility of bringing about the new. Deleuze's argument for a non-representational and relational theory of sensory knowledge is original and exciting in the history of 20th-century philosophy, precisely because it gave to aesthetics such a generative capacity, beyond art or artistic expression per se, and closer in fact to metaphysics. From Deleuze, then, I wish to retain this profound and radical insight: aesthetics concerns ontological creation. Differently from Deleuze, however, and also differently from aisthetic approaches to the digital that openly borrow from Deleuze, I do not believe that the possibility of the new is predicated uniquely upon the virtual.

I thus differentiate between virtuality and potentiality. This is because I am concerned that, as long as we describe the ontological potentiality of digital technology in terms of virtuality, we always need to presuppose an *associated milieu* between the discrete operations of digital computers on the one hand, and the continuity of lived experience on the other. I am using the expression 'associated milieu' here as a loosely Simondonian term (see Simondon, 1989), where Simondon's focus on rehabilitating the modes of existence of technicity vis-à-vis their non-technical environment is a direct source of inspiration for both Deleuze and Deleuzian perspectives. In my view, an overly exclusive attention to the associated milieu between the discreteness of digital computers and the continuity of lived experience might give rise to a conceptual problem, insofar as it misses the ontological specificity of digitality. In other words, we do not truly have an aesthetics of discreteness, then, but an aesthetics of discrete parts that are stirred, or in fact *transduced* (to employ another Simondonian expression) to 'reach beyond [the digital's] flat plane' (Evens, 2010: 147) and partake of an unexhausted field of potential generation that, for a Deleuze-inspired digital aisthesis, would correspond to the intensive and qualitative differentiation of the affective plane.

My criticism of theories of the digital that are based around the Spinozist-Deleuzian notion of affect develops from my argument against the virtualization of digital computation. Whilst I surely do not deny the importance of embodiment and sensation for digital culture and digital aesthetics, and whilst I very much welcome the success of affect theories in highlighting this importance, I also insist that we should not forget that computing machines are 'engines of logic' (Davis, 2000). That is to say, they are the technological realizations of those strategies of formal abstraction that deductive thought has developed over many centuries in order to organize and make sense of reality. Although they involve (and are also implemented upon) the sensible, these strategies of formal

abstraction cannot be flattened down upon the virtuality of sensation. Correspondingly, and insofar as digital technologies are engines of logic that employ these strategies of formal abstraction, digital computation has a relation with the intelligible. This relationship is formal, extensive and informational, and cannot be seen to directly resemble an energetic, intensive plane of affects. An aesthetics of the digital must, therefore, be able to speak of the materialities of computing, whilst also accounting for computation's formalized and formalizing relation with the intelligible.

To think, according to the Deleuzo-affective paradigm, is to feel. It is worth remembering here that this is not simply an *enactivist* position, which would equate cognition to 'doing' (see, for instance, the proposition of Noë, 2004). Rather, Deleuze's argument is, once again, metaphysical. His aversion to rational organization and formal representation is a consequence of his theorization of the sensible as a 'shock to thought' (Deleuze, 2013: 161): what is there to be felt impacts upon thought, and thereby produces a 'thinking-feeling' (Massumi, 2011) – an expression of reality's potentiality to immanently differentiate itself into percepts and concepts. Because of their logico-mathematical character, however, digital machines offer a type of organization of reality that is uneasily contained within this Deleuzian metaphysical schema. Because of their logico-mathematical character, digital machines thus require us to consider a different metaphysical relation between thought and sensation in computation.

Here I need to clarify that the quantitative that I take as the object of my proposed onto-aesthetic investigation should not be understood solely in terms of the binaries and discontinuous values of digital information, but should in fact be understood in terms of the many operations of discretisation behind computational formalization and computational logic. Of course, computing technologies are marked by discreteness because they work with and through digits and numbers. I would also stress, however, that contemporary computing machines are discrete because they *compute*. Throughout history, computation has taken many forms, of which digital computers are the latest, but not the last, incarnation. From the abacus to smart phones, to compute is to systematize the real through quantitative abstractions. To compute is to organize the world, to measure it, to quantify it, to rationalize it, and to arrange it via logico-quantitative means. In the 20th century, the systematizing operations of computation accelerated to the point where they reached the unprecedented scale and speed that we find today. The success of contemporary calculating technologies owes much to the formalization of the notion of computability, as proposed in the pioneering and parallel propositions of Emil Post (1936), Alonzo Church (1936) and Alan Turing (1936). I would argue that these 20th-century formalizations of the informal notion of computation have made *abstractive discretization* a specific method of calculation. This formal method is *axiomatic*

and *algorithmic*. When we compute, informally, we use abstractive techniques to arrange reality into a set of discrete relations between equally discrete entities. When machines compute, formally, they put a task into the finite and defined terms of executable instructions, the aim of which is to axiomatically determine consequences, or outputs, from validly symbolized premises (inputs). Via Turing's foundational work in computability theory, moreover, the activity of computation has been formally equated to that of discretizing a task into the algorithmic form of a rule-governed activity that can be addressed as a sequential succession of countable, separable and finite steps. Whilst it is true that the discrete nature of computation precedes the formal instantiation of computation into a finite-state machine such as the computer, it is also true that discreteness is at the formalist heart of the axiomatic and algorithmic method that computation has come to be. In both cases – whether informally or formally – discreteness is bound to contemporary computational technologies in a way that is much more profound than any simple handling of zeros and ones.

The issues that I have discussed so far show that the computational is a broader category than the digital, but they also indicate that what the computational and the digital have in common is discreteness. In this sense, any aesthetics of digital technologies is first and foremost a *computational aesthetics* (Fazi and Fuller, 2016). As such, any aesthetics of the digital is an aesthetic of discreteness, which must account, on the one hand, for the discrete features of digital technologies, such as digits and pixels, but also, on the other hand, for those finite steps that characterize computation as an axiomatic and algorithmic method. This leads me to address again the ontological impasse between continuity and discreteness that, I have argued, troubles contemporary aesthetic investigations of digital media. I can recast this impasse here, one last time, by phrasing it in the figurative terms of a fracture between logic and aesthetics. Amongst all the articulations that I have so far given to the deadlock between continuity and discreteness, the pinpointing of this supposed defeat of the relation between logic and aesthetics is, for me, the most crucial. This is because it highlights the sense in which an affirmative answer to the question at stake here (that of whether aesthetics is a viable mode of investigating digital computation) should derive from the possibility to repair said fracture and overcome said defeat.

Digital media, insofar as they are computational, are technologies with a systematizing and rationalizing logical capacity. Focusing on the digital-as-computational offers a way to recuperate these systematizations and rationalizations that are proper to the logical activities of computation, and place them at the core of the aesthetic investigation of digital technologies. The issue that needs to be considered is whether such logical operations of computation have an aesthetic legitimacy in their own right. In engaging with this question, one should avoid flattening down

the logical-quantitative dimension of digital computation upon the qualitative and intensive sensibilities of lived experience (aisthesis). Similarly, however, it is also crucial to avoid returning to any rhetoric of dematerialization. When looking at the formal character of computation, one must ask whether computational *logos* can be aesthetic beyond the Platonic postulation of beautiful, transcendent and eternal mathematical forms. Whilst, metaphysically speaking, this means refusing to endorse simplicity over complexity, from a more sociocultural perspective this move beyond a Platonic aesthetics of mathematical forms involves objecting to technocultural narratives about an infallible and all-encompassing algorithm perfection. Moreover, in more aesthetic terms, it involves not prioritizing the elegant and the beautiful when considering computing vis-à-vis the rationality, formality and functionality of computational systems.

Formal Abstraction

We can now fully appreciate how, and why, an aesthetic study of digital computation must be an ontological one: that it must be, in other words, a study of what digital computation is and does. If we are to look at digital computation from an ontological perspective, however, we cannot avoid addressing those algorithmic and axiomatic techniques of abstractive discretization that enable digital computational systems' existence – that are, undeniably, a fundamental part of digital computational systems' reality.

Being abstract, according to a Deleuzian framework, means being indeterminate, and being indeterminate, for Deleuze, means being virtual. In this sense, life is abstract, and so is thought: both maintain a profoundly indeterminate aspect insofar as their virtuality is never fully realized and never fully represented, but rather immanently lived in and through sensation and experience. The algorithms and axiomatic operations of computers, however, are abstract not in this Deleuzian sense, but in a much more technical and formalist sense. To be abstract, in computer science, involves moving away from the particularity of lived experience. In my view, this abstractive character of computation is a crucial aspect of digital technology that we should not downplay. An affective understanding of the digital, however, could be said, in part, to do just that, for this abstractive character would jeopardise the virtuality that they instead ascribe to digitality. Following Deleuze, an affective theory of the digital would consider formalization as an instrumentalist residue of cognitivism, a tool for producing 'images of thought' that is only good for empty communications and cold predictions.

In this respect, my proposition is different. I certainly value the success of affective theories of digitality in moving past the 'profound if often unconscious Cartesianism' (Davis, 2003: 13) of technoculture, and I do

so because I want to move past it too. Rather than downplaying the formally abstractive character of computation, however, I am placing it in centre-stage. This is because I wish to investigate philosophically the nature of formal abstraction in computation, beyond the representational and cognitivist roles that we have assigned to it. Thus, whilst I agree with the premises of Deleuzo-affective approaches to the digital, I disagree with their conclusion. Formal abstraction should not be bypassed but reconsidered. At the same time, it should be reconsidered not because we can render it qualitative or somewhat virtual, but because we can argue that it is onto-aesthetic (i.e. productive and generative) in virtue of its actual quantitative character, not despite of it.

I can now say that my attempt to theorize a computational aesthetics of discreteness is predicated upon the possibility of finding complexity in formal abstraction. This involves challenging the view – epitomized here by Deleuze, although it is by no means limited to him, and it is in fact a longstanding position in philosophy – that computation is an epistemic reduction of the ontological dynamism of thought (it is worth remembering that thought, for Deleuze, is ontologically dynamic because it is always immanent to virtual sensation). In order to explain this central point in my argument, it is useful to position the onto-aesthetic reconceptualization of the formal character of digital computation that I am advocating against the backdrop of the current crisis of formalism within cognitive and computer science. Such a crisis has different (ideological, as well as pragmatic) origins, but shares with philosophical critiques of computation (such as that of Deleuze discussed in this article) a general discouragement or distrust towards anything representational, as well as the intention to consider instead what could be referred to as the 'sensible dimension' of thought: to find 'mind in life' (Thompson, 2007) but also 'intelligence without representation' (Brooks, 1991) – that is to say, complementarily, 'intelligence without reason' (Brooks, 1995). Interestingly, then, the crisis of formalism within cognitive and computer science also exemplifies how technoscience believes computation to be a reduction.

To expand on these issues, we can briefly consider the programme of *strong AI* and related computationalist theories of the mind. Strong AI believes that it is possible to build a fully intelligent machine, capable of performing the full human spectrum of intellectual tasks. Computationalism, in turn, considers cognition as a form of natural computation: to think, in this view, is to elaborate inputs into outputs by following rules. In recent decades, and responding to the failure of strong AI in delivering such intelligent machines, post-computationalist positions in cognitive science and robotics have instead advanced alternative models of thought, and have laid the basis for an understanding of thinking as the *situated* relation between the inside of a mind and the outside of an external, factual world. The rise of so-called 'embedded computing' mirrors this attention towards computer systems that are

physically and socially positioned, and which harness our world in its behavioural and perceptual continuity. Similarly, design and computing positions according to which interactive behaviour is not reducible to algorithmic programmability reject the strictly formal notion of what is computable on the grounds that algorithms, or formal rules, cannot engage with situated complexity. The basic algorithmic model of what computation is has thus been challenged by new conceptualizations of the computing machine, which focus not on internal procedures but on external interaction, and which interpret interactive behaviour as the continuous directionality of composite parts, which would return us the opacities and uncertainties of individual and social life.

We can see this multifaceted paradigmatic shift in models of computing across a wide spectrum of computational investigations and, moreover, in everyday practices ranging from social media calls for participation to post-desktop and post-digital gadgets. In the contemporary scenario of embedded and social computing, one can argue that the laws of formalization have been somehow dismissed in favour of the laws of experience. The formal abstractions of computation are said to be incapable of catching the mutability and variability of the real world. Of course, the disavowal of formalism on behalf of technoscience is different from any such dismissal that might be based on Deleuze's work, or on philosophy in general. What I am also keen to stress, however, is that it is possible to find a common denominator, or a shared reason for that dismissal, in the fact that digital computational systems are not very good at dealing with indeterminacy. For computer science and technology businesses, this is not an insuperable problem. Whilst algorithms are designed to be more akin to the empirical rather than the formal, the basic computationalist assumption – and the main lesson of cybernetics – remains: computation is control, and the more computation can control the indeterminacy of empirical particularity by making itself akin to it, the more computation, and technological businesses, work well. For Deleuze, however, the fact that computing is a determinist enterprise that does not deal well with indeterminacy is a damning conclusion. To turn to empirical mutability is not enough; what Deleuze and, consequently, strictly Deleuzian approaches to digital media are after is the transcendental affective dimension of experience, not its sense-data.

It is important to situate attempts to construct an aesthetic of discreteness, such as mine, in relation to these issues, and in relation to the impact that computationalist or post-computationalist agendas have upon society and culture. Doing so shows that engaging with the possibility of constructing an aesthetic ontology of digital computation is, undoubtedly, an exercise in speculative metaphysics, but one that constitutes a crucial part of a shared effort, on behalf of philosophy and cultural theory, to further the investigation of the computational infrastructures that engender modes of thinking, acting and perceiving in the

21st century. An aesthetic critique of these computational infrastructures would have to focus on challenging the totalizing and transcendent character of the latter, and on questioning the way in which computation, insofar as it is calculation, pushes for a positivist attention towards the universal whilst forgetting the particularity of life and sensation. In other words, an aesthetic critique of these computational infrastructures would have to warn against the risk of trusting a regime of instrumental rationality.

Having said this, it should be added here that my attempt to reconsider formal abstraction in computation philosophically is not intended as an endorsement of the totalizing and instrumental tendencies of computational systems either. Rather, it needs to be understood as a continuation of philosophical criticisms of instrumental rationality. However, I go about this critique in a profoundly different way. It could be argued that a digital aesthetics/aisthesis would look at formal calculation in order to challenge it, and to consequently get rid of it. I challenge formal abstraction too; however, I do not wish to dispose of it, precisely because I want to find in the formal heart of calculation the reason for it to be more than, or other to, a reductive and all-enframing tool of the complexities of the real. Like Deleuze, and Deleuze-inspired theories of the digital, I also believe that computation is not the same as, and cannot account for, life, the living and the lived. My point, however, is that it does not have to: we can find a form of indeterminacy in the formal system, and it is for this reason that the formal system can be aesthetic, in the Deleuzo-ontological sense, but still quantitative, discrete, formal.

Another Indeterminacy: Incomputability

In order to find *another indeterminacy* in computation it is necessary, first of all, to assess what indeterminacy might be vis-à-vis discretization in computation, and to thus prove whether computational systems have their own way of being indeterminate. This other indeterminacy would have to be found within the logical, formal and axiomatic character of computing. It would have to be the indeterminacy of the digital discrete, and not of the virtual continuum. Equally, it would have to be predicated not upon the simplicity of mathematical forms but, on the contrary, upon the complexity of axiomatic systems, which are established (and thrive) upon their very own actual *logical incompleteness*. That axiomatic systems are always incomplete is something that was famously demonstrated by the logician Kurt Gödel in 1931. Gödel's *incompleteness theorems* show the existence of statements that, when viewed from the outside, are certainly true, but the provability of which cannot be deduced inside the formal axiomatic system in question (see Gödel, 2004). I now wish to propose that it is from this crucial discovery in

mathematical logic that we need to start our search for this other indeterminacy in computation. This moment in the history of formal reasoning points us to another key moment in the history of computing: a foundational one, in fact, when the mathematician Alan Turing first formalized the notion of computability into a method for manipulating sequences of finite steps. These sequences of finite steps are the algorithmic procedures in which I am trying to identify indeterminacy.

According to Turing's algorithmic model of computation, to compute is to follow an effective, determinate and deterministic procedure (i.e. an algorithm) in order to solve a problem in a finite number of subsequent steps. In his 1936 foundational paper 'On Computable Numbers, with an Application to the Entscheidungsproblem', however, Turing demonstrated that some problems cannot be solved via algorithmic means, because the steps involved in their processing are not finite, but rather infinite: these problems are therefore incomputable. I have discussed Turing's 1936 paper at length in Fazi (2016b), where I explained the conceptual and historical links between Turing's notion of incomputability and Gödel's notion of incompleteness, and the way in which both notions were replying, in the negative, to the mathematician David Hilbert's 1900 programme for certainty, consistency and completeness in the foundations of mathematics. My concern there was to show that computation's preprogrammed procedures should be understood not as an all-encompassing and preformed total determinism, but as processes of determination that are always exposed to, and in fact ingressed by, indeterminacy. I claimed that this indeterminacy qua incomputability thus allows us to consider the latter as an 'open-ended axiomatics', marked by what I called a 'contingent formalism'. I will not repeat that argument here, but I will rather build on it to stress that we can mobilize Turing's notion of incomputability in order to move beyond a strictly Deleuzian approach to the aesthetic of the digital, whilst still pursuing Deleuze's radical ontologization of aesthetic enquires. This is because the incomputable allows us to argue that indeterminacy does not pertain uniquely to virtual life, but that it can also be found within computational logic itself.

The incomputable is a formal, logical and quantitative indeterminacy that is central to computational systems, and which does not contradict their functionality. On the contrary, it grounds it. This is key: the incomputable is not an accident, not an error, not a glitch and not even a chance event. The incomputable is not a mistake for the computational system, but the founding condition thereof. Because the incomputable is this element of 'undecidability' (Gödel, 1986) that is logically inscribed into every computation, something in computation remains unknown and, ultimately, beyond representation. This unknown is a crucial element of the actual procedures of computation: it does not belong to life or sensation (whether factually empirical or affectively virtual), but to

computation itself. To put this otherwise: although this indeterminacy is beyond symbolic representation, it is still within logos. By mobilizing the notion of incomputability we are, then, taking a distance from virtualizations of digital computation, and engaging instead with the possibility of finding, in the abstractive and discretizing operations of computation themselves, a computational indeterminacy that does not have to simulate, or be translated into, the indeterminacies of life or lived experience. We are thus engaging with the indeterminacy of discrete processes of determination that, by virtue of formal abstraction, encounter the infinite quantities of incomputable functions. Equally, by stressing what I believe to be the significance of the incomputable for the ontological investigation of computation, it is possible to begin to compose an understanding of computation, and of its many formalisms, that does not operate as a reductive 'image of thought'. It is not despite of, but rather because of formal abstraction that computation proves to be a procedure that is already complex. A virtualization of the digital would have needed to find this complexity in the prior coupling of computation with lived experience; we, however, insofar as we are looking for an aesthetics of discreteness, do not need to do so. In fact, we can argue that this complexity results from the ingression of a quantitative infinity that remains unrepresentable, and thus impractical or useless from representational, cognitivist and instrumental perspectives.

This article has offered some initial contributions towards a description of what an aesthetics of computational discreteness might amount to. My primary aim has been to point beyond the virtualization of digitality and towards a full ontological consideration of the nature of discretization in computation. I can now conclude by returning to the question that was posed in my opening paragraph: is it legitimate to consider the abstractive capacities of computation in aesthetic terms? I am now in a position to expand on the positive answer that I anticipated there, and to explain that my proposed attempt to establish a computational aesthetics that would not flatten down the logico-quantitative character of computing upon qualitative transductions has to be understood as an attempt to justify the abstractive capacities of computation beyond the representational role that we have often assigned to them. By identifying the incomputable as an *indeterminacy of quantities*, we can say that an aesthetic of the digital is viable, albeit with the caveat that this aesthetics would have to extend the field of ontological enquiry of computation from the sensible to the intelligible: to extend it, that is, from the plane of sensuous reception and qualitative transformation of computational practices to that of the logico-quantitative operations of computational structures themselves. The differentiation between digitality and virtuality that I am advocating is not an attempt to say that the sensible is not important, but that the sensible, when considering the aesthetics of computation, is not enough.

This differentiation between digitality and virtuality then involves asking: if the digital is not virtual, is it possible that the logico-mathematical quantities of computation might have their own capacity to generate the new? An aesthetic enquiry into digital computation must involve an attempt to respond to this question.

In this respect, to look for another indeterminacy in computation, and to find this indeterminacy within computational formalization, would involve looking for, and finding, *another potentiality* in the ontology of computing. Again, this would have to be the potentiality of the digital, rather than that of the virtual. We are looking for the potential of the discrete algorithmic procedure, before that procedure is coupled or assembled with art (as traditional aesthetics would have it), or associated with virtual sensation (as a Deleuzian aesthetics would wish for). This potentiality of the discrete algorithmic procedure would vouch for its aesthetic validity, insofar as it would attest to its generative capacity. Therefore, to find another indeterminacy in computation would also be to open up the possibility of talking about an aesthetics of the digital procedure per se. The task implicit in this quest to find another indeterminacy, another potentiality and another aesthetics, involves the possibility of offering a view of computational formalism that would afford a critique of representationalism and cognitivism on the one hand, and that would not reduce the logico-quantitative character of computation to an affective plane on the other.

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